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Mediating verbal responses and stimulus similarity as factors in conceptual naming by school-age children.

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MEDIATING VERBAL RESPONSES AND STIMULUS SIMILARITY AS FACTORS IN CONCEPTUAL NAMING BY SCHOOL-AGE CHILDREN

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TABLE OF CONTENTS

Page

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INTRODUCTION

The first objective of this study was to determine the effects on conceptual naming of four patterns of relationships among line-drawing initiating stimuli, verbal mediating responses and stimuli, and verbal terminating responses. The second objective was to determine the effects on conceptual naming of two degrees of similarity of the initiating stimuli. The third objective was to determine the joint effects on conceptual naming of the patterns of relationships and degree of similarity. Predictions concerning the direction and relative amounts of these effects for both degrees of similarity of the initiating stimuli are developed for each pattern separately and in relation to the others. Before these predictions are made, however, some extra-laboratory or practical considerations which served as the background of this study are noted. Then presented are some of the theoretical and related experimental materials concerning mediating responses in concept formation which influenced the more specific objectives and methods of this study. Also, since an understanding of the patterns of relationships is presupposed in the development of predictions, each of the four patterns is described along with data on the role of two of them in generalization and discrimination.

Practical Considerations

Concept-formation tasks are tasks whose stimuli differ

with respect to two or more dimensions or attributes such as height and size or a common form with different accompanying features. When each of the stimuli is chosen or named by responding in terms of one or only some of the dimensions or attributes (e.g., height; the common form) while not responding in terms of the remaining attributes (e.g., size, the different features) it is said that a concept has been learned. Concepts then, are not entities but rather are such patterns of relationships between multi-attribute stimuli and responses to those stimuli. In conceptual naming the responses are verbal rather than motor.

The stimuli and stimulus-response relationships of many tasks differ from and are often more complicated than those of the preceding examples. However, such tasks can and do involve patterns of relationships among multi-attribute stimuli and responses to those stimuli which can be labeled as concepts. For example, children are expected to learn that some older women are "aunts" while others are "not aunts." But children must also learn that some aunts are "mother's sisters" while other aunts are "married to mother's brothers." In teaching children these responses, one might begin by training them to distinguish between "aunts" and "not aunts" and then, when they have learned which older women are "aunts," teach them to discriminate between aunts who are "mother's sisters" and aunts who are "married to mother's brothers."

The opposite sequence might also occur. After learning to label some older women as "mother's sisters" and others as "married to mother's brothers," children might then be required to call both sets of older women "aunts."

Both sequences present problems for the child. In the first case, after having to learn to give one name to those older women who are aunts, the child then has to give some of those women a second name which is different from the first and to give others of the aunts a still different name. The situation of the second sequence involves learning a common name (aunt) for two sets of adults whom the child has just learned to discriminate among as "mother's sisters" and "married to mother's brothers."

Relative similarity and dissimilarity of the older women in terms of appearance, manner and mode of dress must also be considered. Should all of the aunts be similar to each other and different from other older women in age, appearance, manner and mode of dress, the child might readily learn the common name "aunts," but, only with great difficulty, learn to discriminate between "mother's sisters" and "married to mother's brothers." Conversely, in addition to the aunts as a group differing from other older women, should "mother's sisters" differ from the "wives of mother's brothers" in age, appearance, and mode of dress, discriminating between the two sets might be relatively easy, while learning to call them by the common name "aunt" might be relatively more

difficult.

Similar problems arise in most areas of children's learning to label. Thus, while some furry animals are cats, they are also Siamese, Persian, "Alley" and other kinds of cats. Among the other furry animals, different from cats, are dogs, which are Beagles, Collies, thoroughly bred, and other kinds. Other four-legged things, which have backs and arms but do not move, are chairs. There are also dining-room chairs, kitchen chairs, living-room chairs, and "father's chair."

The relative ease with which further common or different responses are conditioned to these sets of stimuli, as with the set of "aunt" stimuli, might be influenced by prior acquisition of different or common responses, respectively. Relative similarity of the stimuli of the sets may also facilitate or retard acquisition of further responses.

Because the "aunts," "cats," "dogs," "chairs," and other sets of stimuli are initial cues for responses, such sets are called initiating stimuli. Arousal of the common or different responses first conditioned to these initiating stimuli would produce stimuli which, in turn, might influence the conditioning of a further common response or further different responses to the initiating stimuli. Hence these responses and stimuli, which might mediate between initiating stimuli and the further responses, are labeled mediating responses and stimuli. The further response or responses of

these sequences are called terminating responses.

Within this classification of actual and potential stimuli and responses of concept-formation tasks as initiating stimuli, mediating responses and stimuli, and terminating responses, the first of the sequences described above involves learning a common mediating response (aunts) to different initiating stimuli which is followed by learning to respond to the same initiating stimuli with different (or discriminative) terminating responses (mother's sisters, married to mother's brothers). In the second sequence, learning mediating discriminative responses ("mother's sisters," "married to mother's brothers") is followed by learning a common terminating response ("aunts").

Verbal Mediating Responses in Concept Formation

The significance for concept formation of verbal mediating responses or, more accurately, of patterns of relationships among initiating stimuli, verbal mediating responses and stimuli, and verbal or motor terminating responses has been stressed in a number of recent theoretical analyses (Goss, 1957; Osgood, 1953; Spiker, 1956). Illustrative of such analyses is Osgood's statement that "It would seem that the only essential condition for concept formation is the learning of a common mediating response (which is the meaning of the concept)..." (Osgood, 1953, p. 668). But investigations in which common or discriminative verbal mediating responses were either observed directly or established

experimentally are of recent origin.

Baum (1951) found that ease of learning Heidbreder's object, form, and number concepts varied inversely with the number of different labels for successive instances of the same concept. But she concluded that the number of Ss and their protocols were not sufficient for a reliable conclusion.

In the first of a series of studies employing a modified Hanfman and Kasinin (1942) block-sorting task, Fenn and Goss (1957) investigated transfer to sorting by height-size as a function of acquisition of common nonsense-syllable or familiar-word labels for blocks within each of four height-size categories. They hypothesized that acquisition of common labels for blocks within each of four height-size categories would increase intra-category similarity and decrease inter-category similarity of the block stimuli and thus facilitate subsequent sorting by height-size. As predicted, groups of matched normal adults and paranoid schizophrenic adults who had learned to label by height-size then sorted by height-size more often than their controls. Corroborative findings with nursery school children have been reported by Carey and Goss (1957). Further, Goss and Moylan (1958) demonstrated that height-size placements increased with degree of mastery of nonsense-syllable and familiar-word labels assigned in terms of height-size. Finally, Lacey (1956) obtained direct relationships between number of height-size placements and

both number of labels and degree of mastery. Consistent with these findings are those of Hunter and Ranken (1956) who found that Ss who had previously labeled the middle two of six colors as either "magenta" or "vermilion" sorted the six stimuli in a manner congruent with the labeling responses.

These studies are consistent in their suggestion that the occurrence or prior learning of verbal mediating responses facilitates subsequent sorting of stimuli into conceptual categories. However, they have several limitations. First, except for Baum (1951), who used Heidbreder's (1946a; 1946b) stimuli and nonsense-syllable responses, the stimuli employed have only been combinations of physical dimensions and the terminating responses have only been motor choices. Further, Carey and Goss (1957) excepted, the Ss have been adolescents or adults. Although both response-mediated generalization and discrimination presumably contribute to concept formation, in no study has the design permitted separate assessment and comparison of the roles of these two paradigms. Also, two other patterns of relationships among stimulus-response components of complex tasks, which are described below, have been completely ignored. Finally, in none of these studies of conceptual behavior has the effects of similarity of initiating stimuli been assessed.

These limitations determined the Ss, the nature of the stimuli, and the variables of the present study. First, the initiating stimuli were more similar to pictorial

representations of common objects and less readily conceived as combinations of physical dimensions. Second, the terminating responses were nonsense syllables. Third, the Ss were children. Fourth, four paradigms of possible relationships among initiating stimuli, mediating stimuli and responses, and terminating responses were included; and the design provided for determination of their separate effects as well as for comparisons of those effects. Finally, each of these four paradigms was combined with two degrees of similarity of initiating stimuli.

Patterns of Relationships

Fig. 1 shows the four patterns of relationships among initiating stimuli, mediating responses and stimuli, and terminating responses which were investigated in this study. Pattern A is the mechanism which Dollard and Miller (1950) have labeled the acquired equivalence of cues or response-mediated generalization. In this pattern acquisition of a common verbal response to two or more initiating stimuli is followed by acquisition of a common terminating response.

Acquired distinctiveness of cues or response-mediated discrimination are the labels commonly applied to Pattern B (Dollard & Miller, 1950; Goss, 1955). Highly dissimilar verbal mediating responses are learned to each of two or more initiating stimuli. Subsequently, discriminative terminating responses are conditioned to the initiating stimuli to which the discriminative mediating responses were learned.

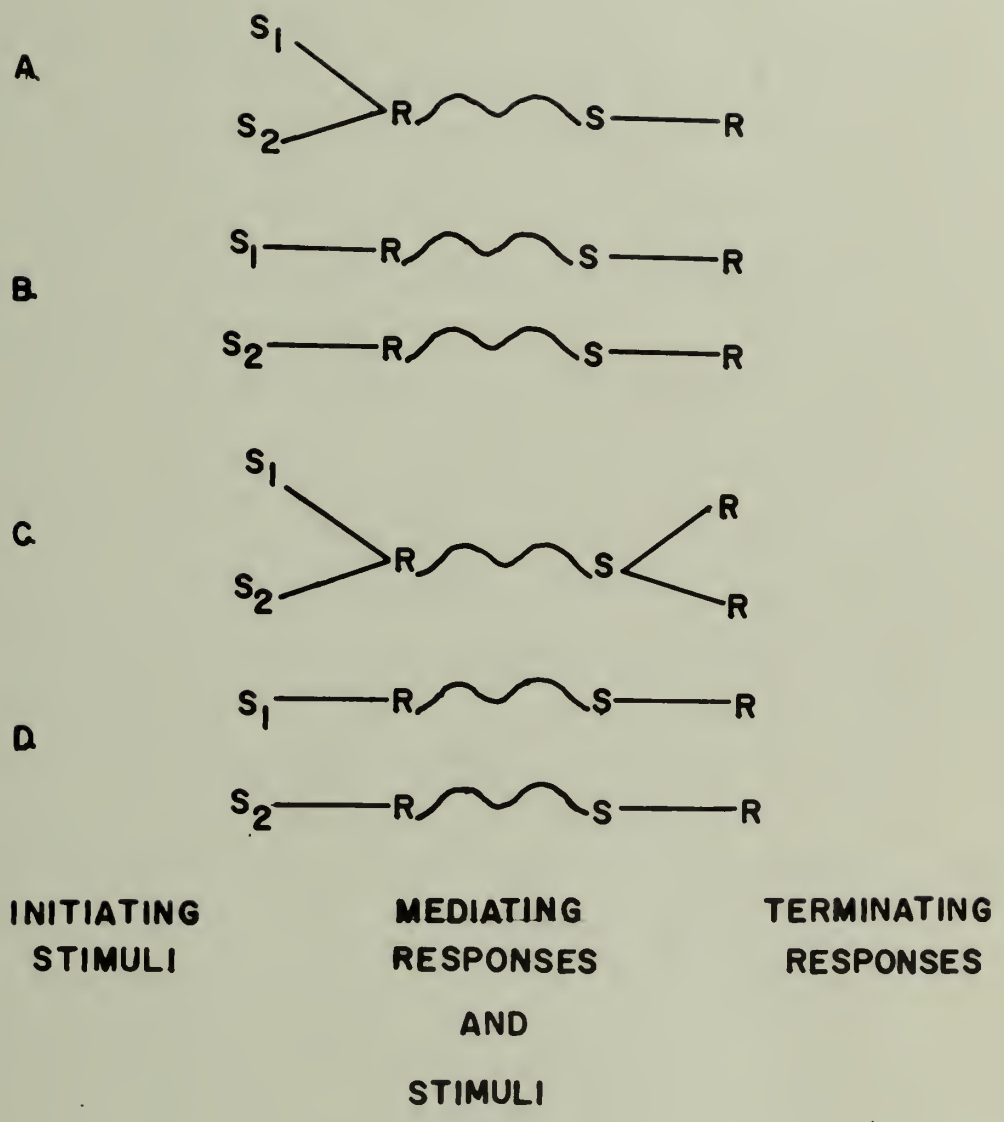

Fig. 1. The four patterns of relationships among initiating stimuli, common or discriminative mediating responses and stimuli, and common or discriminative terminating responses.

Positive transfer to the acquisition of common terminating responses based on the acquired equivalence of cues has been demonstrated with relatively simple stimuli and stimulus-response relationships (e.g., Birge, 1941; Grice, 1958; Jeffrey, 1953; Murdock, 1952). Others (e.g., Goss & Greenfeld, 1958; Grice, 1958; Spiker, 1956) have reported that acquisition of discriminative verbal mediating responses facilitates subsequent acquisition of discriminative terminating responses to relatively simple stimuli.

Although the existence of Patterns C and D has been noted previously (Goss, 1955) and these patterns were used in the preceding illustrations involving the naming of aunts, neither pattern has been included in prior investigations of effects of relationships involving mediating verbal responses. Pattern C is one in which a common response is first learned to two or more initiating stimuli. Ss are then required to learn different terminating responses to each of the stimuli instead of learning a further common response as is the case for Pattern A. In Pattern D, different verbal mediating responses are conditioned to initiating stimuli after which a common terminating response to those stimuli is strengthened.

Predictions

Three sets of predictions were formulated regarding acquisition of common or discriminative verbal terminating responses under experimental conditions in which mediating responses and stimuli of Patterns A, B, C, and D were

expected to be present relative to acquisition of those terminating responses under control conditions in which mediating responses and stimuli were not expected to be present. (The exact procedure for the control condition is described in the section on "method.") The first set of predictions concern relative levels of mastery or rates of acquisition of terminating responses for each of the four patterns of relationships separately as functions of experimental and control conditions and of degree of similarity of initiating stimuli.

Patterns A, B, C, and D separately.--In Pattern A, the experimental condition involved learning a common mediating response to two sets of initiating stimuli after which a common terminating response was learned to these same initiating stimuli. Because the presence of mediating responses and stimuli was expected to increase the similarity of the initiating stimuli, it was predicted that the common terminating response would be acquired more rapidly under the experimental condition than under the control condition. Also, regardless of pretraining conditions, acquisition of the common terminating response was expected to be faster with similar initiating stimuli than with dissimilar initiating stimuli. The basis for both predictions was the more general principle that interstimulus generalization of responses is directly related to similarity of initiating stimuli and of compounds of initiating and mediating stimuli (Dollard &

Miller, 1950; Osgood, 1953).

The presence of a common mediating stimulus might occasion an increase in the similarity of dissimilar stimuli different than the increase in the similarity of dissimilar stimuli. If so, different amounts of facilitation should be obtained with similar than with dissimilar initiating stimuli to occasion a significant interaction of control and experimental conditions with similar or dissimilar initiating stimuli. Present data and theories, however, provided no satisfactory basis for the prediction of relatively greater facilitation either with similar or with dissimilar initiating stimuli.

In Pattern B, discriminative mediating responses were conditioned to the initiating stimuli after which discriminative terminating responses to those stimuli were learned. Accordingly, an experimental condition with discriminative mediating responses and stimuli was expected to produce faster acquisition of discriminative terminating responses than the control condition. Also, because rate of acquisition of discriminative responses increases with dissimilarity of stimuli (Dollard & Miller, 1950; Osgood, 1953), faster learning of discriminative terminating responses was predicted for dissimilar than for similar initiating stimuli.

It might be assumed that stimuli resulting from dissimilar mediating responses produce a greater increase in the dissimilarity of similar than of dissimilar initiating

stimuli.[1] If so, acquisition of discriminative mediating responses should produce greater facilitation in the learning of discriminative terminating responses to similar than to dissimilar initiating stimuli.

Because the presence of the common mediating stimulus in Pattern C should increase the similarity of initiating stimuli, less rapid acquisition of discriminative terminating responses was expected under the experimental condition than under the control condition. Disregarding experimental and control conditions, faster acquisition of discriminative terminating responses was predicted for dissimilar than for similar initiating stimuli. Both predictions were based on the principle of a direct relationship between ease of learning discriminative responses and similarity of initiating stimuli and of compounds of initiating and mediating stimuli (Dollard & Miller, 1950; Osgood, 1953).

As for Pattern A, the common mediating stimulus might occasion an increase in the similarity of similar initiating stimuli different than the increase in the similarity of

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1. Data bearing on this assumption for somewhat complex stimulus patterns involving two or more stimulus modalities (visual for figure; proprioceptive, auditory for verbal response-produced stimuli) are, to the author's knowledge, nonexistent. Though the extension to the condition of this experiment is tenuous, this assumption is consistent with Miller's analysis of the effects on discrimination of multidimensional variations in tastes, colors, points, and tones in which he concluded "clearly, the addition of independently variable attributes to the stimulus increases the channel capacity, but at a decreasing rate" (Miller, 1956, p. 88).

dissimilar initiating stimuli and thus occasion differences in amounts of retardation relative to the control conditions. Again, however, available data and present theory do not warrant a specific prediction.

The different mediating stimuli of Pattern D presumably increased the dissimilarity of the initiating stimuli to which the common terminating response is to be learned. Accordingly, acquisition of the common terminating response was expected to be slower under the experimental than under the control condition. Because of the direct relationship between rate of acquisition of a common response and similarity of stimuli (Dollard & Miller, 1950; Osgood, 1953), faster learning of the common terminating response was expected with similar than with dissimilar initiating stimuli.

As for Pattern B, it might be assumed that dissimilar mediating stimuli produce a greater increase in the dissimilarity of similar than of dissimilar initiating stimuli. Should this assumption be correct, acquisition of discriminative mediating responses should result in less retardation with dissimilar than with similar initiating stimuli.

Comparisons between and among Patterns A, B, C, and D.--Pattern A and Pattern D both have a common terminating response but differ in that the former has a common mediating response while the latter has discriminative mediating responses. With either similar or dissimilar initiating stimuli, it was predicted that the common terminating response

would be acquired more rapidly with Pattern A than with Pattern D. This prediction follows from two earlier predictions of facilitation or positive transfer due to the common mediating response and stimulus of Pattern A and of retardation or negative transfer due to the discriminative mediating responses and stimuli of Pattern D.

While Pattern B and Pattern C have discriminative and common mediating responses, respectively, both have discriminative terminating responses. In Pattern B, the presence of distinctive mediating stimuli was expected to facilitate acquisition of discriminative terminating responses, while in Pattern C, the presence of the common mediating stimulus was expected to retard acquisition of discriminative terminating responses. The prediction was, therefore, that, disregarding degree of similarity of stimuli, more correct discriminative terminating responses would be obtained with Pattern B than with Pattern C under the experimental condition and across control and experimental conditions.

Lacey (1956) observed that rate of learning varied inversely with the number of responses for the conceptual naming of blocks. Though his initiating stimuli and those of this study bear little resemblance, his finding provides some basis for predictions that, disregarding degree of similarity of the initiating stimuli, the common terminating response of Pattern A and of Pattern D should be acquired

more rapidly than the discriminative terminating responses of Pattern B and of Pattern C, respectively. It follows, that more correct terminating responses should be obtained with Patterns A and D together than with Patterns B and C together. Further, because of the predictions that terminating responses should be acquired faster with similar than with dissimilar stimuli for Pattern A and the converse for Pattern B, it was also expected that Patterns A and B would interact with degree of similarity. The predictions of faster acquisition of terminating responses with similar than with dissimilar stimuli for Pattern D and of the converse for Pattern C, generated the prediction of an interaction of these patterns with degree of similarity.

For all 16 combinations of conditions, the most rapid learning was expected for Pattern A with similar initiating stimuli under the experimental condition. The slowest learning was expected for Pattern C with similar initiating stimuli under the experimental condition. Both predictions were based on the notion of similar initiating stimuli made even more similar by a common mediating stimulus. For the former such great similarity should be facilitative, while for the latter it should be inhibitory. Performances of the remaining 14 combinations were of course expected to be between these extremes. Orders of performances within particular groups of some of the 14 combinations were predicted by the first two sets of hypotheses. A prediction of the order of

all 14, however, could not be made with sufficient bases or precision to warrant the attempt.

METHOD

Design

Rationale for control condition.--Previous work had indicated that the influence on transfer of the acquired equivalence and the acquired distinctiveness of cues must be assessed against controls for the effects of two factors which are presumed to occur during the training phase of transfer studies and to then affect performance during the transfer phase (Goss, 1955; Goss & Greenfeld, 1958; Spiker, 1956). One of these factors is warm up or learning set in the form of experiences such as familiarization with the conditions of stimulus presentation, with the paired-associates technique, and with the general requirements of a concept formation task and, more specifically, of both generalization and discrimination responses to initiating stimuli. The other factor is experience in orienting to the common or distinctive features of the initiating stimuli which are relevant to formation of the concepts. Since neither factor is specific to the particular associations formed during training and transfer phases, they have been referred to as nonspecific bases of transfer (Osgood, 1953).

In this study the control for any facilitation of the acquisition of common or discriminative terminating responses due to warm up was the use of a control condition in which common or discriminative responses were conditioned to sets

of initiating stimuli which did not resemble the sets of initiating stimuli of the transfer phase. Because features of the training and transfer phases other than the set of initiating stimuli were the same, however, those experiences involved in warm up, other than specific associations between the initiating stimuli and responses of the training phase, were expected to generalize from the training phase to the transfer phase. Because of differences in specific features as well as general characteristics of the sets of stimuli of the training and transfer phases, it was not expected that specific responses would generalize from the former to the latter phase. Prior learning with sets of stimuli not resembling those of the transfer phase, therefore, provided for facilitation of the acquisition of common or discriminative terminating responses based on warm up or nonspecific associations while it precluded the presence of specific associations involving common or discriminative mediating responses and stimuli.

Facilitation based on receptor-orienting responses was controlled by the use of two parallel sets of similar initiating stimuli and two parallel sets of dissimilar initiating stimuli which required the same receptor-orienting responses. Thus, receptor-orienting responses to the set of stimuli of the training phase and to the parallel set of stimuli of the transfer phase would be the same under both experimental and control conditions. Because the stimuli of the parallel

similar and parallel dissimilar sets of stimuli differed with respect to the nature of the features to which the orienting responses were made as well as in their general characteristics, no generalization of specific associations involving mediating responses and stimuli from training to transfer phases was expected.

Combinations of conditions.--Under the experimental condition each of the four patterns of relationships among initiating stimuli, mediating responses and stimuli, and terminating responses was combined with both similar and dissimilar initiating stimuli. Corresponding to each of these eight combinations was a control for the combined effects of nonspecific transfer and receptor-orienting responses. Thus, in all, there were 16 combinations of conditions.

For each combination of experimental or control conditions with similar or dissimilar initiating stimuli, each S was administered both Pattern A and Pattern B or both Pattern C and Pattern D. Because two patterns were administered to each S, only eight rather than 16 separate groups were required to realize the 16 combinations of conditions.

There were two reasons for assigning two patterns to each S. One was that with only a limited number of Ss available, administration of two patterns to the same S required half as many Ss as a design in which different Ss were assigned to each of the 16 combinations of conditions. More importantly, as shown in Fig. 2, by combining Pattern A with

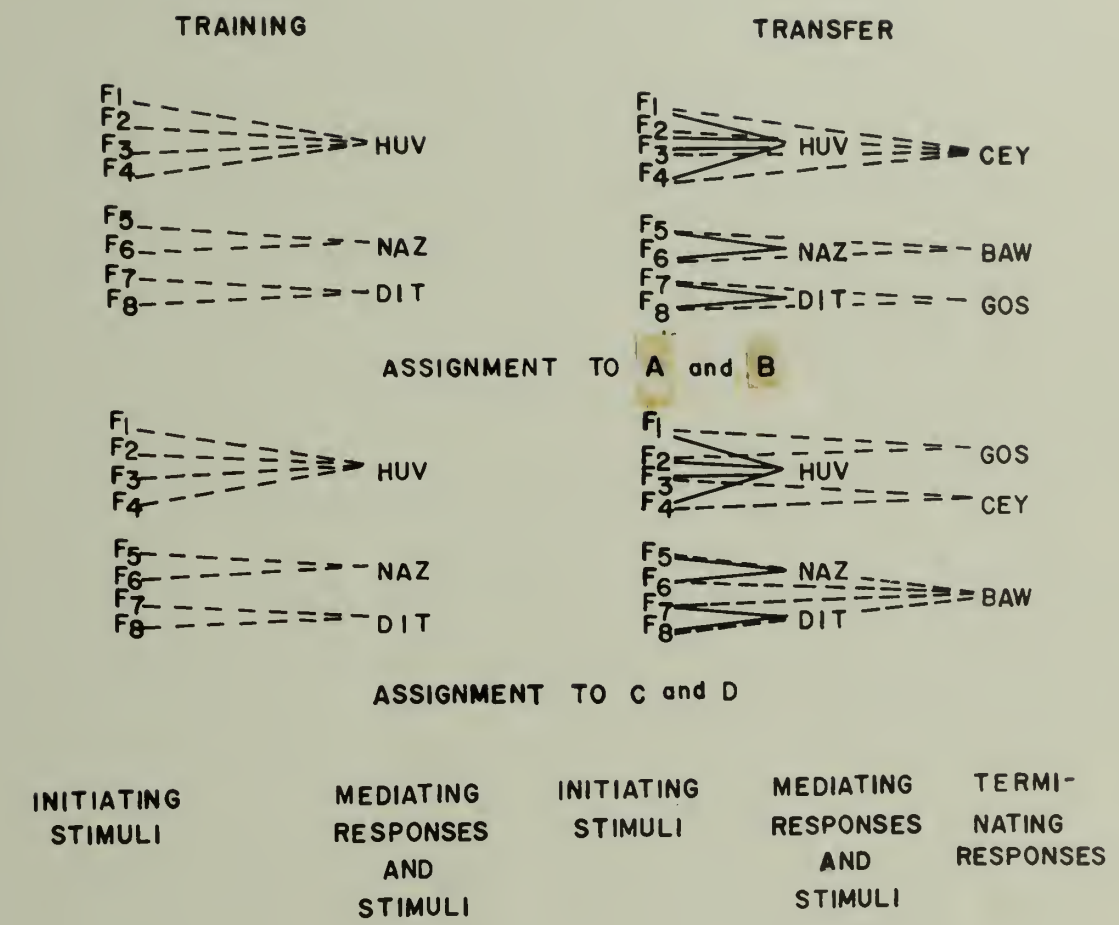

Fig. 2. The relationships among initiating stimuli, mediating responses and stimuli, and terminating responses for assignment to Patterns A and B or to Patterns C and D with similar or dissimilar face initiating stimuli. The relationships with house stimuli were the same. Under the experimental condition the initiating stimuli of both the training phase were identical. Under the control condition the face or house initiating stimuli of the training phase were replaced by house or face stimuli, respectively, for the transfer phase. The broken lines indicate associations to be established and the solid lines indicate already established associations.

Pattern B and Pattern C with Pattern D, all Ss learned three responses to the initiating stimuli of the training phase and three responses to the initiating stimuli of the transfer phase. Also, both the training and the transfer phases for all Ss then involved learning a common response to one set of stimuli and discriminative responses to the other set of stimuli. Only by combining Pattern A with Pattern B and Pattern C with Pattern D was it possible to equalize the two phases in terms of numbers of responses Ss were to learn and with respect to acquisition of common and discriminative mediating as well as terminating responses.

Stimuli and Responses

The stimuli were the four sets of eight line drawings of stylized faces or houses reproduced in Figs. 3a, 3b, 3c, and 3d. In order to have an irrelevant dimension each of the eight drawings of each set was printed on blue, green, yellow, and pink pastel paper. Thus, there were 128 stimuli in all. The 16 faces are all of the same size as are the 16 houses. The area of the faces, excluding the hair, is essentially the same as the area of the houses, excluding the chimney and smoke.

The faces of one set (Fig. 3a) differ from each other with respect to direction and degree of curvature of the hair, eyes, and mouth. These faces are relatively more dissimilar than those of the other set (Fig. 3b) which differ from each other only with respect to direction and degree of

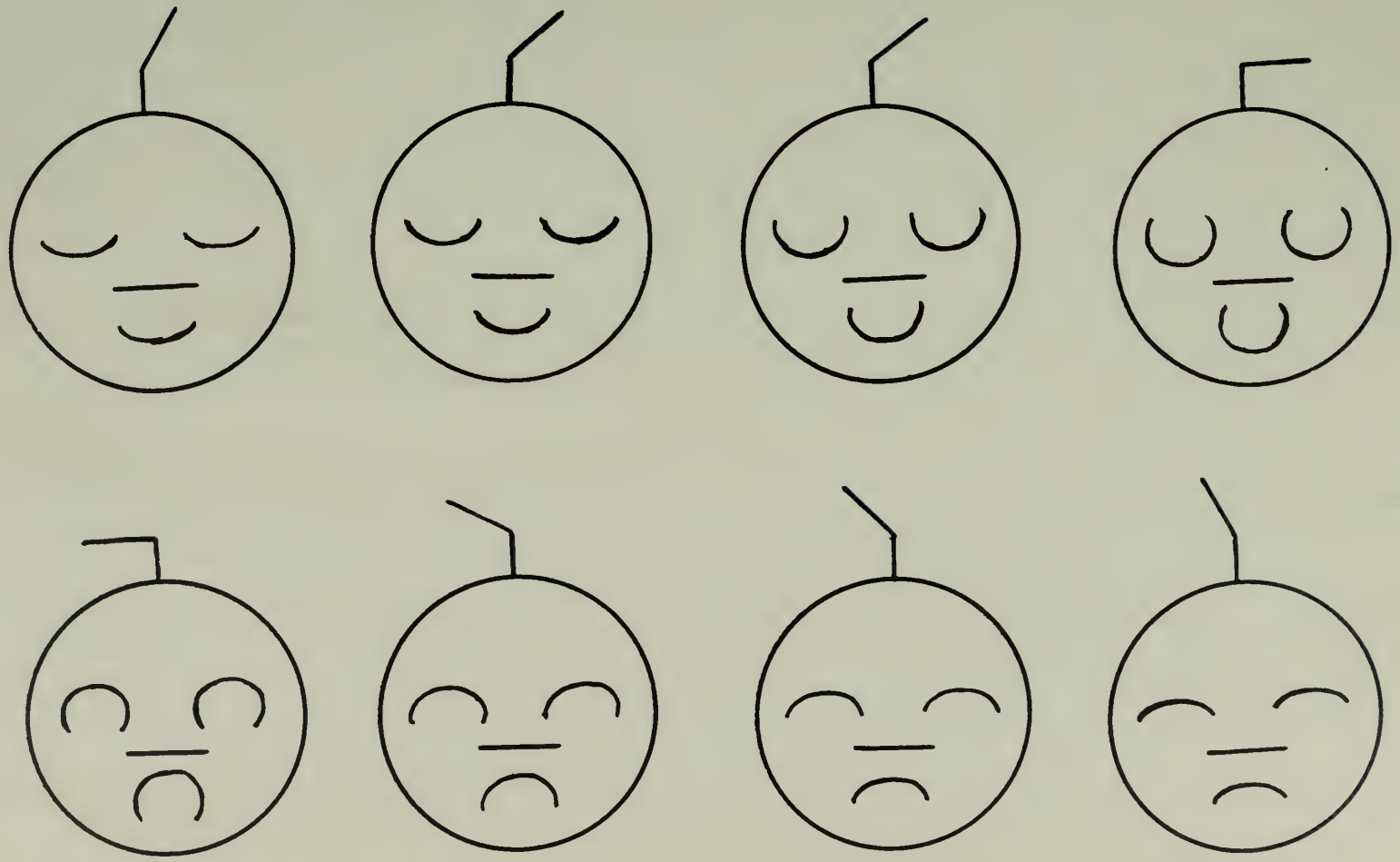

Fig. 3a. Faces differing in direction and degree of curvature of hair, eyes, and mouth (three attributes).

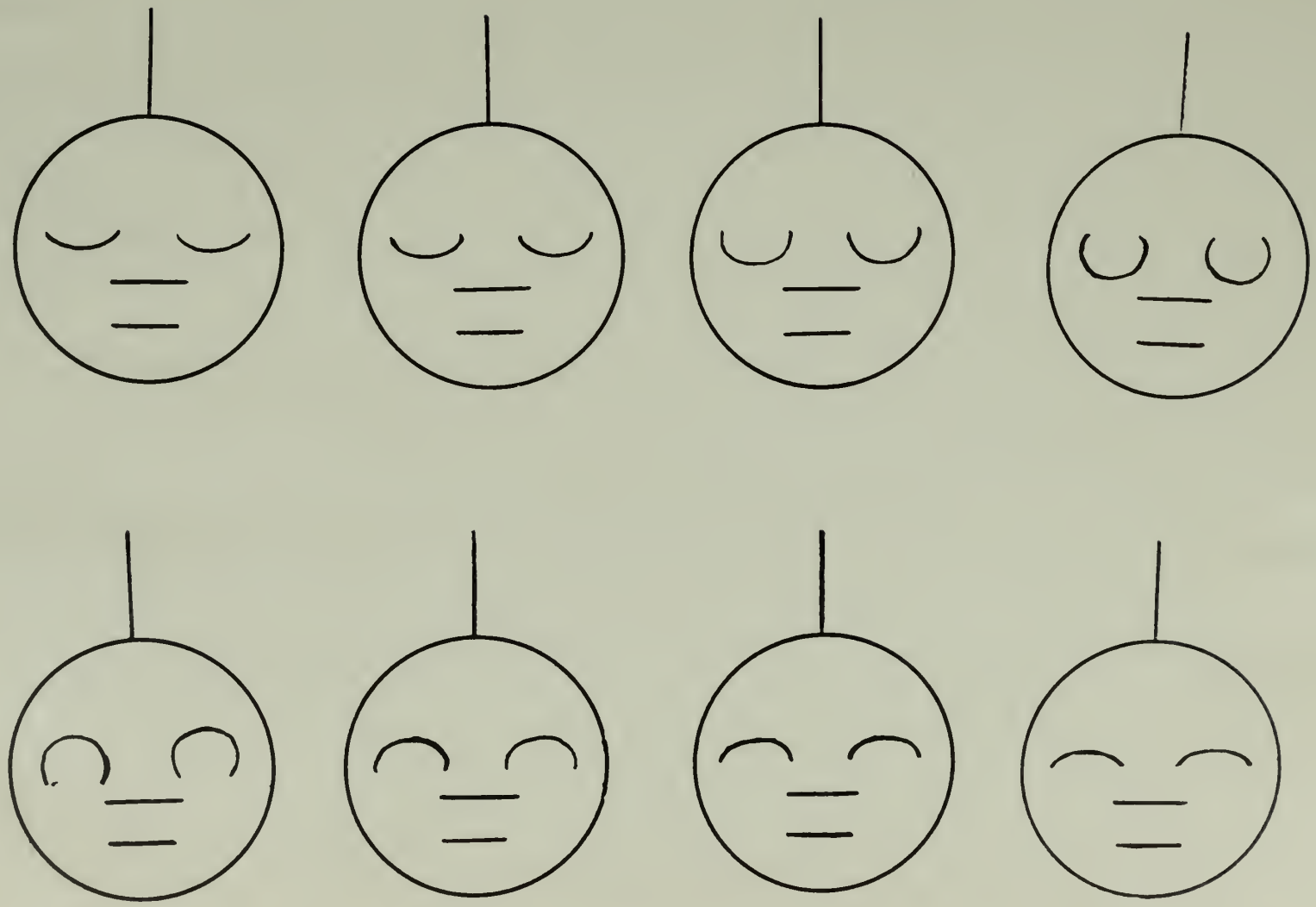

Fig. 3b. Faces differing in direction and degree of curvature of the eyes (one attribute).

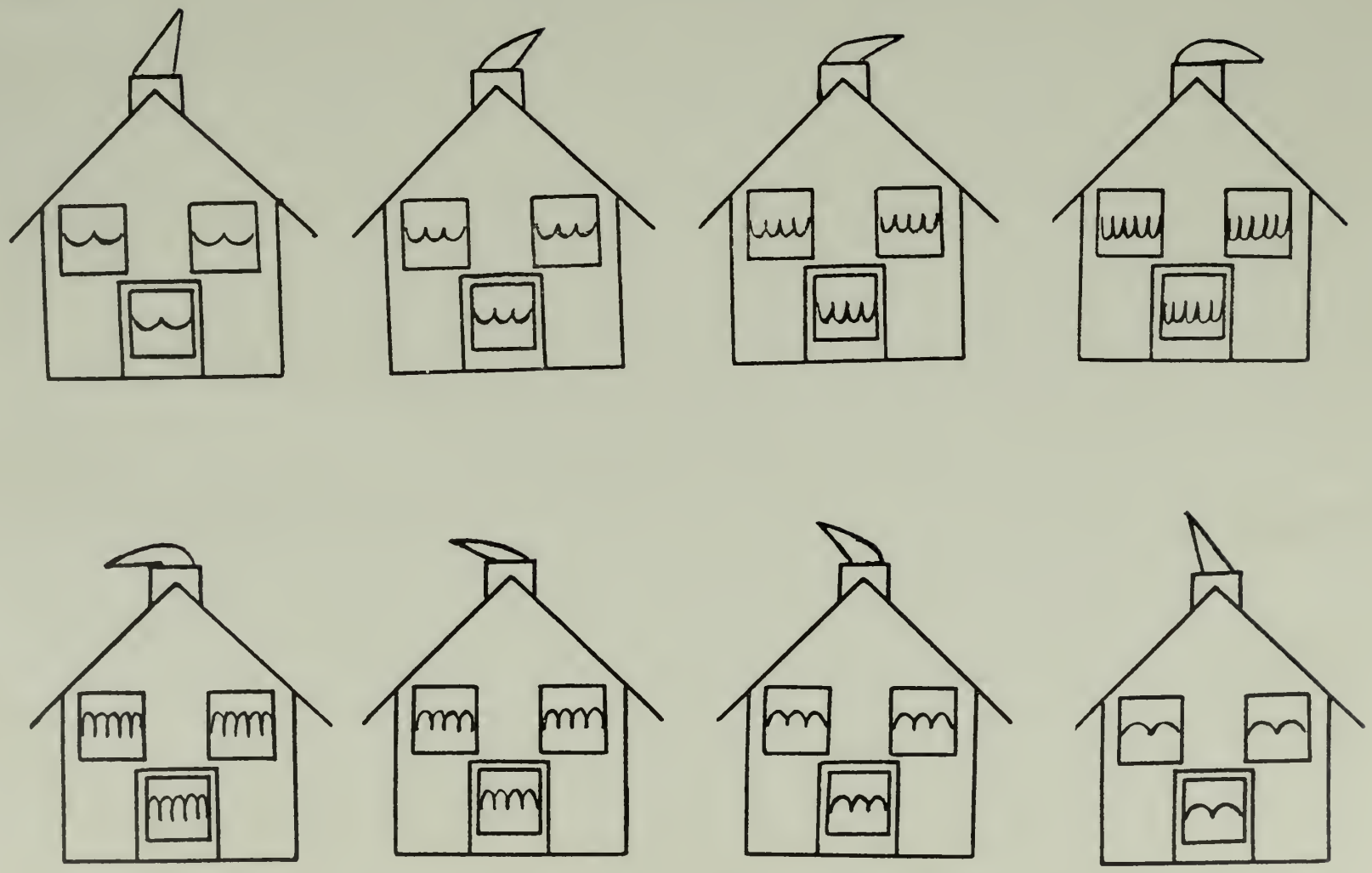

Fig. 3c. Houses differing in direction and degree of curvature of smoke and in direction and number of scalloped edges of curtains of the windows and of windows of doors (three attributes).

Fig. 3d. Houses differing in direction and number of scalloped edges of curtains of the windows (one attribute).

curvature of the eyes. The hair of all eight of the similar faces is a straight line rising vertically from the center of the top of the head; the mouth is a horizontal line.

The houses of one set (Fig. 3c) differ from each other with respect to direction and degree of curvature of the smoke from the chimney, and in number (five, four, three, two) and degree of curvature of the scalloped bottoms of the shades in the two windows and of the shade in the window of the door. These houses are relatively more dissimilar than the eight houses of the other set (Fig. 3d) which differ only with respect to number and degree of curvature of the scalloped bottoms of the shades in the two windows. The smoke from all eight rises vertically from the chimneys and the bottoms of the shades of the windows in the doors are all straight lines.

The hairs and the smoking chimneys, the eyes and scalloped bottoms of the shades of the windows, and the mouths and scalloped bottoms of the shades of the doors have the same locations. Therefore, receptor-orienting responses to critical features of the sets of faces and houses of comparable similarity were expected to be equivalent. Any pre-experimentally acquired names aroused by critical features of the faces, however, were expected to be almost entirely different than those aroused by critical features of the houses. And these features of the faces and houses as well as the over-all characteristics of the faces and houses are

sufficiently dissimilar so that nonsense syllable responses were not expected to generalize from houses to faces or from faces to houses.

Nonsense syllables.--The six nonsense syllables used were selected from among those of Mandler's (1955) list which have high associative frequencies (association values). Huv (as in hover), naz (as in Nazarene), and baw (as in bawd) were the mediating responses and cey (rhymes with say), dit (as in ditto), and gos (as in gospel) were the terminating responses.

Apparatus.--The apparatus consisted of a vertical panel in which a small window (5 in. x 3 in.) had been cut. Behind and on both sides of the window were guides to correctly position the 3 x 6 in. plastic cards on which the stimuli appeared. When the plastic card was dropped between the guides at the top it slid into position to fill the window and the bottom of the card tripped a microswitch which activated a time delay relay set for 3 sec. At the end of the 3 sec. interval a bulb on the front of the apparatus lighted to signal the end of the anticipation interval.

Procedure

The same sequence of training and transfer experiences was administered to each of the eight groups. During the training phase, Ss were familiarized with the mediating responses before those responses were conditioned to the initiating stimuli of Patterns A and B or of Patterns C and D.

The Ss were then familiarized with the terminating responses of the transfer task before they began the task of associating those responses with the initiating stimuli.

Within this common sequence of experiences, however, the eight groups differed in three ways. First, four of the groups had similar initiating stimuli and the other four had dissimilar initiating stimuli. Second, each of these halves was further divided into two groups, which were assigned to Pattern A and Pattern B, and two other groups, which were assigned to Pattern C and Pattern D. Each of these pairs of groups was then divided into an experimental group, for which the initiating stimuli were the same for both training and transfer phases, and into a control group, for which the initiating stimuli of the training phase did not resemble those of the transfer phase. The experimental groups were those for which the arrangements of the training and transfer tasks were designed to realize Patterns A and B or Patterns C and D. In contrast, the arrangements for the control groups were designed to assure facilitation due to warm up and receptor-orienting responses, while precluding the presence of the mediating responses and stimuli necessary to realize the four patterns. The controls, then, were groups in which mediating responses and stimuli were presumably absent.

In order to counterbalance for any differences due to experiences with face stimuli or with house stimuli, half of the Ss of each of the four groups under the experimental

condition had faces for both transfer and training phases, and the other half of each group had houses for both training and transfer phases. Under the control condition, half of the Ss of each of the four groups had faces for the training phase and houses for the transfer phase, while the other half of each group had houses for training and faces for transfer. Thus, within each of the eight groups, there were two subgroups which were counterbalanced for possible differences due to faces or houses.

Within these subgroups, each pattern was assigned equally often to the four stimuli of each set with subscripts 1, 2,3,4 and to the four stimuli of each set with subscripts 5, 6,7,8 (Fig. 2). Thus, assignment of the patterns to one or the other of these subsets of the sets of faces and houses was also counterbalanced.

Familiarization with mediating responses.--Familiarization training was introduced to assure that Ss pronounced the syllables uniformly. Also, such training was expected to reduce extra-list responses to the initiating stimuli. Finally, since familiarization involved learning the syllables, Ss who might have difficulty in mastering the syllables could be identified and eliminated.

Familiarization training began by E telling each S that he was to say some short syllables in the same way that E said the syllables. The S was also told to try to memorize the syllables so that when asked by E to do so, he would be

able to recite the syllables to E. Each of the three syllables was then presented three times, once within three successive three-trial blocks. Their order within blocks was random. On each trial E said the syllable after which S pronounced it. If S mispronounced the syllable, E corrected him and asked him to say the syllable again. At the end of nine trials E asked S to name the syllables. Those who were able to remember and pronounce the syllables correctly then started the training task. Those who were unable to remember and pronounce the syllables correctly were given six additional trials, two with each syllable. No S was discarded for failure to remember and pronounce the syllables correctly after these additional trials.

Training.--The mediating responses of Patterns A and B or of Patterns C and D were acquired by the paired-associates technique. Each trial consisted of the presentation of one of the face or house stimuli for three sec., after which the bulb lighted and E said the syllable for the response which S was to associate with that stimulus. Whether or not S had anticipated correctly he was instructed to say the syllable after E. When S had done so, the stimulus was removed and the next stimulus was presented. The time interval between successive trials was not controlled; it averaged about 3 sec.

In order to better equalize the strengths of responses to each of the initiating stimuli, the method of adjusted

learning was employed. When the correct anticipations for particular stimuli had occurred on three successive trials, those stimuli were removed. After all three responses reached this criterion, their stimuli were reintroduced and presented until the correct response for each stimulus occurred one more time.

Since each of the eight different stimuli of the four sets of similar or dissimilar face or house stimuli was printed on four different colors of paper, within each set there were 32 figure-color combinations. Each of the eight different faces or houses of a set appeared once within successive blocks of eight trials each. Within these blocks their order was random. The particular color on which each face or house appeared within each block of trials was determined randomly, within the restriction that each figure-color combination appeared once within successive blocks of 32 trials each.

Familiarization with terminating responses.--The instructions and procedures for familiarization with the terminating responses were identical to those for familiarization with mediating responses. However, the three nonsense syllables were those which were to be the terminating responses of the transfer task. No S was eliminated for failure to learn these responses.

Transfer.--All Ss were given 32 trials to learn common or different terminating responses to the initiating stimuli.

These stimulus-response relationships were also learned by the paired-associates method. Each of the eight faces or eight houses of each set of stimuli appeared once within successive blocks of eight trials. Within blocks their order was random. The particular color on which each face or house appeared within each block of trials was determined randomly within the constraint that each of the 32 figure-color combinations appeared once within the 32 trials.

Subjects

The Ss were 96 children from the Erving School Union (Leverett, Shutesbury, Wendell, New Salem, Erving) drawn from among those between the ages of eight and 11 in grades two through six. The eight groups of 12 Ss each and, within these groups, subgruops for face or house stimuli of six Ss each to which the children were assigned, were equated as nearly as possible for sex and for means and ranges of ages and IQ's. To aid in equating for IQ, all children with IQ's of less than 90 or more than 125 were excluded. (Ages, IQ's, and numbers of boys and girls in each group and subgroup are given in the Appendix.)

RESULTS

Training

The data of the training phase provided information about acquisition of the common or discriminative mediating responses to the sets of similar and dissimilar face and to the sets of similar and dissimilar house stimuli. Of interest were the questions of whether the sets of similar face and similar house stimuli were of equal difficulty, and whether the sets of dissimilar face and dissimilar house stimuli were of equal difficulty. Also of concern was whether learning rates and pre-transfer experiences were equal both for the four groups assigned to Patterns A and B or to Patterns C and D under experimental or control conditions which responded to similar stimuli, and for the four corresponding groups which responded to dissimilar initiating stimuli.

The columns for "faces," "houses" and "faces and houses" and the rows for "E," "C," and "E and C" conditions of the upper half of Table 1 present means and standard deviations of numbers of trials to reach the criterion of three successive correct anticipations of the common mediating response for Patterns A and C. The further breakdowns for these patterns show means and standard deviations for combinations of similar or dissimilar faces or houses, and subsequent assignment to experimental or control conditions. Presented in the

Table 1

Means and Standard Deviations of Trials to the First Criterion of the Training Phase

Pattern	Similarity	E and C	Faces			Houses			Faces and Houses		
			N	M	SD	N	M	SD	N	M	SD
A	Similar	E	6	15.8	8.9	6	21.8	6.3	12	18.8	8.3
		C	6	18.8	5.9	6	19.0	8.0	12	18.9	5.4
		E & C	12	17.3	7.7	12	20.4	5.8	24	18.9	7.0
	Dissimilar	E	6	22.8	12.4	6	18.7	5.6	12	20.8	9.8
		C	6	20.0	7.9	6	22.7	9.8	12	21.3	8.8
		E & C	12	21.4	10.5	12	20.7	8.0	24	21.0	9.3
C	Similar	E	6	19.0	3.8	6	21.3	8.0	12	20.2	6.3
		C	6	19.8	9.0	6	20.2	8.0	12	20.0	8.5
		E & C	12	19.4	6.9	12	20.8	8.0	24	20.1	7.5
	Dissimilar	E	6	16.8	3.5	6	18.3	6.9	12	17.6	5.5
		C	6	16.8	9.1	6	13.3	5.0	12	15.1	7.9
		E & C	12	16.8	6.9	12	15.8	6.9	24	16.3	6.9
A & C	Similar	E	12	17.4	7.0	12	21.6	7.2	24	19.5	7.4
		C	12	19.3	7.6	12	19.6	6.7	24	19.5	7.2
		E & C	24	18.4	7.3	24	20.6	7.0	48	19.5	7.3
	Dissimilar	E	12	19.8	9.6	12	18.5	6.3	24	19.2	8.1
		C	12	18.4	8.7	12	18.0	9.1	24	18.2	8.5
		E & C	24	19.1	9.2	24	18.2	7.8	48	18.7	8.6

Table 1 (continued)

Pattern	Similarity	E and C	Faces			Houses			Faces and Houses		
			N	M	SD	N	M	SD	N	M	SD
B	Similar	E	6	24.2	7.1	6	27.3	12.2	12	25.8	10.1
		C	6	27.7	8.1	6	32.3	5.5	12	30.0	7.3
		E & C	12	25.9	7.8	12	29.8	9.8	24	27.9	9.1
	Dissimilar	E	6	32.3	11.5	6	28.5	5.8	12	30.4	9.3
		C	6	19.8	7.2	6	28.7	11.1	12	24.2	10.4
		E & C	12	26.1	11.4	12	28.6	8.9	24	27.3	10.3
D	Similar	E	6	25.8	7.1	6	31.0	5.1	12	28.4	6.7
		C	6	29.8	7.5	6	24.0	10.2	12	26.9	9.4
		E & C	12	27.8	7.6	12	27.5	8.8	24	27.7	8.2
	Dissimilar	E	6	25.2	4.5	6	28.7	11.4	12	26.9	8.8
		C	6	27.2	5.6	6	25.3	6.4	12	26.2	6.1
		E & C	12	26.2	5.2	12	27.0	9.4	24	26.6	7.6
B & D	Similar	E	12	25.0	7.2	12	29.2	9.5	24	27.1	8.7
		C	12	28.8	7.9	12	28.2	8.4	24	28.5	8.6
		E & C	24	26.9	7.8	24	28.7	9.4	48	27.8	9.8
	Dissimilar	E	12	28.8	9.4	12	28.6	9.0	24	28.7	9.2
		C	12	23.5	7.4	12	27.0	9.2	24	25.2	8.6
		E & C	24	26.1	8.9	24	27.8	9.2	48	27.0	9.1

lower half of Table 1 are comparable means and standard deviations of numbers of trials to learn both of the discriminative mediating responses of Patterns B and D to the criterion of three successive correct anticipations. Since the task was not mastered until both responses had reached criterion, these means are based on sums of trials to criterion for both discriminative responses.

The second criterion of one further correct anticipation of the common mediating response and of each discriminative mediating response was achieved by most Ss on the first trial on which the stimuli for each of these responses were reintroduced. At most only three further trials, including the criterion trial, were required. Thus, these scores added little or no information to that provided by number of trials to the criterion of three successive correct responses. For this reason, and because of marked skewness of the distributions, trials to the second criterion were not analyzed further.[2]

The significance of differences among these means was assessed by the analysis of variance summarized in Table 2. The factors which had been varied systematically were face or house stimuli, their similarity or dissimilarity, and

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2. Numbers of trials for each S to learn the common mediating response and both discriminative mediating responses to the first and second criterion are reproduced in the Appendix. Also given are the numbers of correct common and discriminative terminating responses during the transfer phase.

Table 2

Analysis of Variance of Trials to Criterion during the Training Phase

Source	df	SS	MS	F
Between Ss	95	10715.87		
Faces-Houses (B)	1	68.88	68.88	-
Similar-Dissimilar (C)	1	30.88	30.88	-
AB-CD (D)	1	59.63	59.63	-
Experimental-Control (E)	1	27.76	27.76	-
BC	1	30.88	30.88	-
BD	1	47.01	47.01	-
BE	1	12.50	12.50	-
CD	1	125.13	125.13	1.04
CE	1	97.75	97.75	-
DE	1	9.63	9.63	-
BCD	1	12.50	12.50	-
BCE	1	131.68	131.68	1.09
BDE	1	277.92	277.92	2.30
CDE	1	53.13	53.13	-
BCDE	1	84.01	84.01	-
error (b)	80	9646.58	120.58	
Within Ss	96	6277.50		
Common-Discriminative (A)	1	3291.80	3291.80	112.16**
AB	1	13.54	13.54	-
AC	1	.01	.01	-
AD	1	19.38	19.38	-
AE	1	3.25	3.25	-
ABC	1	26.26	26.26	-
ABD	1	11.51	11.51	-
ABE	1	2.77	2.77	-
ACD	1	86.67	86.67	2.96
ACE	1	45.05	45.05	1.53
ADE	1	7.13	7.13	-
ABCD	1	.87	.87	-
ABCE	1	9.61	9.61	-
ABDE	1	94.91	94.91	3.23
ACDE	1	148.75	148.75	5.07*
ABCDE	1	168.15	168.15	5.73*
error (w)	80	2347.84	29.35	
Total	191	16993.37		

* Significant at the .05 level
** Significant at the .001 level

acquisition of common mediating or discriminative mediating responses. Though Ss were pre-assigned to Patterns A and B or to Patterns C and D under experimental or control conditions, these were not systematic factors until the transfer phase. Each S learned both a common mediating response and two discriminative mediating responses; this factor was a "within Ss" effect while the other four factors were "between Ss" effects.

Only three F's were significant. The first of these indicated that, disregarding the other four factors, the common mediating response was learned faster than the discriminative mediating responses.

For Patterns A and B under the experimental condition, the combinations of common mediating response-similar stimuli, common mediating response-dissimilar stimuli, discriminative mediating responses-similar stimuli, and discriminative mediating responses-dissimilar stimuli had means whose rank-order was 1,2,3,4, respectively. For Patterns C and D under the experimental condition, and for Patterns A and B and Patterns C and D, both under the control condition, the comparable rank-orders were, respectively, 2,1,4,3; 1,2,3,4; and 1,2,4,3. The differences in these rank-orders were the probable basis of the significant ACDE interaction. These same differences in rank-orders, as suggested by the non-significant F for the ratio of the ACDE and ABCDE interactions, were probably the relationship among means reflected

in the significant ABCDE interaction.

Transfer

The performance measure of the transfer phase was the number of correct responses for the 16 trials in which the common terminating responses of Patterns A and D were correct and the number of correct responses for the 16 trials in which one or the other of the discriminative terminating responses of Patterns B and C was correct. Means and standard deviations of numbers of these responses are shown in Table 3 for combinations of: (a) Patterns A, B, C, and D, (b) faces or houses, (c) similar or dissimilar stimuli each (d) under experimental or control conditions. Differences among these means might have been due to any one or more of these factors, either alone or in combination, and also to assignment to Patterns A and B or to Patterns C and D, either alone or in combination with the other factors.

Because Patterns A and B were administered to half of the Ss and Patterns C and D were administered to the other half, the analysis of variance used to assess the significance of the effects of the five factors was somewhat unusual. The "between Ss" sources of variance in which all Ss were involved were: (a) faces or houses, (b) similar or dissimilar stimuli, (c) experimental or control conditions, and (d) assignment to Patterns A and B or to Patterns C and D.

For Ss assigned to Patterns A and B, the "within Ss" sources of variance were Pattern A or Pattern B and the

Table 3

Means and Standard Deviations of Numbers of Correct Common and Discriminative Terminating Responses during the 32 Trials of the Transfer Phase

Pattern	Similarity	E and C	Faces			Houses			Faces and Houses		
			N	M	SD	N	M	SD	N	M	SD
A	Similar	E	6	13.5	.8	6	12.3	1.1	12	12.9	1.1
		C	6	8.5	2.0	6	10.5	1.3	12	9.5	1.9
	Dissimilar	E	6	12.7	.3	6	11.0	2.6	12	11.8	2.4
		C	6	8.8	2.3	6	8.2	1.6	12	8.5	2.0
B	Similar	E	6	11.0	1.9	6	9.7	2.1	12	10.3	2.1
		C	6	5.7	1.0	6	6.3	1.0	12	6.0	1.0
	Dissimilar	E	6	12.3	1.8	6	11.3	1.1	12	11.8	1.6
		C	6	10.0	1.2	6	9.0	2.1	12	9.5	1.8
C	Similar	E	6	5.7	1.2	6	5.8	2.0	12	5.8	1.7
		C	6	8.0	2.3	6	7.0	1.2	12	7.5	1.9
	Dissimilar	E	6	8.0	1.0	6	7.8	2.0	12	7.9	1.6
		C	6	9.0	2.0	6	8.2	2.0	12	8.6	2.0
D	Similar	E	6	7.7	.8	6	8.3	.8	12	8.0	.8
		C	6	8.0	2.6	6	9.3	1.4	12	8.7	2.2
	Dissimilar	E	6	6.0	1.9	6	6.2	.4	12	6.1	1.4
		C	6	9.2	1.9	6	8.5	1.6	12	8.8	1.8

interactions of this factor with faces or houses, similar or dissimilar stimuli, and experimental or control conditions. Each of the latter three factors and their interactions with ezch other were "between Ss" sources, but now for only half of the Ss. For Ss assigned to Patterns C and D, these patterns and their interactions with the other factors were the sources of "within Ss" effects; the other factors were "between Ss" sources.

Differences among the means for these conditions both separately and in combination are analyzed and described in four steps. Considered first are the "between Ss" effects in which all Ss were involved. "Between Ss" and "within Ss" effects for Patterns A and B are then examined, after which attention is given to these effects for Patterns C and D. After analyses of variance for Patterns A, B, C, and D separately are presented, Pattern A is compared with Pattern D and Pattern B is compared with Pattern C.

"Between Ss" for all Ss.--For the "between Ss" effects in which all Ss were involved, Fs significant at beyond the .05 level were obtained for similar or dissimilar stimuli, for assignment to Patterns A and B or to Patterns C and D, and for experimental or control conditions (Table 4). The F for similar or dissimilar stimuli was due to more correct responses with similar stimuli than with dissimilar stimuli. More correct responses were made with Patterns A and B than with Patterns C and D. Finally, there were more correct

Table 4

Analysis of Variance of Correct Responses during the 32 Trials of the Transfer Phase

Source	df	SS	MS	F
Between Ss[a]	95	951.70		
Faces-Houses (B)	1	3.79	3.79	1.03
Similar-Dissimilar (C)	1	14.63	14.63	3.99*
AB-CD (D)	1	273.13	273.13	74.42**
Experimental-Control (E)	1	43.13	43.13	11.75**
BC	1	9.63	9.63	2.62
BD	1	2.13	2.13	-
BE	1	3.26	3.26	-
CD	1	1.50	1.50	-
CE	1	7.13	7.13	1.94
DE	1	277.92	277.92	75.73**
BCD	1	1.27	1.27	-
BCE	1	5.01	5.01	1.37
BDE	1	13.13	13.13	3.58
CDE	1	.89	.89	-
BCDE	1	1.23	1.23	-
error (b)	80	293.92	3.67	
Between Ss[b]	47	451.24		
Faces-Houses (B')	1	6.51	6.51	2.05
Similar-Dissimilar (C')	1	12.76	12.76	4.01
Experimental-Control (E')	1	270.01	270.01	84.91**
B'C'	1	7.60	7.60	2.39
B'E'	1	14.26	14.26	4.48*
E'C'	1	6.51	6.51	2.05
B'E'C'	1	6.51	6.51	2.05
error (b)	40	127.08	3.18	-
Within Ss	48	269.50		
A-B (A')	1	38.76	38.76	10.59**
A'B'	1	.51	.51	-
A'C'	1	75.26	75.26	20.56**
A'E'	1	.01	.01	-
A'B'C'	1	1.26	1.26	-
A'B'E'	1	1.76	1.76	-
A'C'E'	1	5.51	5.51	1.59
A'B'C'E'	1	.01	.01	-
error (w)	40	146.42	3.66	-
Total	95	720.74		

Table 4 (continued)

Source	df	SS	MS	F
Between Ss[c]	47	227.33		
Faces-Houses (B")	1	.04	.04	.01
Similar-Dissimilar (C")	1	3.38	3.38	.82
Experimental-Control (E")	1	51.04	51.04	12.24**
B"C"	1	2.67	2.67	.64
B"E"	1	1.50	1.50	.36
E"C"	1	1.50	1.50	.36
B"E"C"	1	.38	.38	.09
error (b)	40	166.82	4.17	-
Within Ss	48	188.00		
C-D (A")	1	5.04	5.04	1.68
A"B"	1	4.17	4.17	1.39
A"C"	1	37.50	37.50	12.50**
A"E"	1	1.50	1.50	.50
A"B"C"	1	2.04	2.04	.68
A"B"E"	1	1.04	1.04	.35
A"C"E"	1	15.04	15.04	5.01*
A"B"C"E"	1	1.50	1.50	.50
error (w)	40	120.17	3.00	-
Total	95	415.33		

* Significant at the .05 level
** Significant at the .01 level
a. For all Ss
b. For Ss assigned to Patterns A and B
c. For Ss assigned to Patterns C and D

responses under the experimental condition than under the control condition. Only the interaction of assignment to Patterns A and B or to Patterns C and D with experimental or control conditions was significant. Under the control condition there were 8.38 correct responses with Patterns A and B and 8.40 correct responses with Patterns C and D. While these means were significantly lower (*t*s of 6.09 and 6.05, respectively; *p* < .01) than the mean of 11.73 correct responses with Patterns A and B under the experimental condition, they were significantly higher (*t*s of 2.62 and 2.65; *p*s < .01) than the mean of 6.94 correct responses for Patterns C and D under the experimental condition. Since there was a greater increase with Patterns A and B than there was a decrease with Patterns C and D, the positive transfer with the former patterns was greater than the negative transfer with the latter patterns.

Patterns A and B.--The common terminating response of Pattern A was correct more frequently than the discriminative terminating responses of Pattern B (*F* = 10.59; *p* < .01). Further, significantly more correct responses occurred for Patterns A and B together under the experimental condition than under the control condition. Neither faces or houses nor similar or dissimilar stimuli had significant effects, though the *F* for the latter comparison was just short of the .05 level.

Under the control condition, the means of 8.25 correct

responses for face stimuli and of 8.50 correct responses for house stimuli were essentially equivalent. Under the experimental condition there was an increase of 4.13 to a mean of 12.38 (t = 5.66; p < .01) correct responses for face stimuli and an increase of 2.58 to a mean of 11.08 (t = 3.53; p < .01) correct responses for house stimuli. The difference between these two increases was sufficient to produce an interaction (B'E") of the two factors significant at the .05 level.

With Pattern A, the mean of 11.21 correct common terminating responses to similar stimuli was larger, but not significantly larger (t = 1.39; p ≐ .15), than the mean of 10.17 for such responses to dissimilar stimuli. With Pattern B, the mean of 8.17 correct discriminative terminating responses with similar stimuli was significantly smaller than the mean of 10.67 for such responses to dissimilar stimuli (t = 3.33; p < .01). Because of this reversal in relative numbers of correct responses to similar and dissimilar stimuli with Pattern A and with Pattern B, the interaction of these two factors (A'C') was highly significant.

Patterns C and D.--Significantly fewer correct responses occurred under the experimental condition than under the control condition (F = 12.24; p < .01). The significant interaction (A"C") of similar or dissimilar stimuli with Pattern C or Pattern D was apparently brought about by two opposing trends. For Pattern C, the mean of 8.25 correct discriminative terminating responses to dissimilar stimuli

was significantly larger (t = 2.95; p <.01) than the mean of 6.63 to similar stimuli. For Pattern D, fewer correct common terminating responses occurred with dissimilar stimuli (M = 7.46) than with similar stimuli (M = 8.33). The t of 1.58, however, was not significant.

Also significant was the triple interaction (A"C"E") of similar or dissimilar stimuli, Pattern C or Pattern D, and experimental or control conditions. This effect can be attributed to differences in the differences between experimental and control conditions for the four combinations of similar or dissimilar stimuli with Pattern C or Pattern D. Specifically, for combinations of similar stimuli-Pattern C, dissimilar stimuli-Pattern C, similar stimuli-Pattern D, and dissimilar stimuli-Pattern D, the differences between the pairs of means for experimental and control conditions, in the direction of larger means for the control condition, were, respectively, 2.75, 0.66, 0.67, and 2.65. The first (t = 3.57) and last (t = 3.44) of these differences were significant at the .01 level; the second (t = 0.86) and third (t = 0.87) were not significant.

Patterns A, B, C, and D separately.--The sets of face and house stimuli were essentially equivalent (Table 5). Accordingly, this factor was not included in analyses of variance for Patterns A, B, C, and D separately, for each of which the sources of variation were similar or dissimilar stimuli, experimental or control conditions, and the

Table 5

Analyses of Variance of Correct Responses during the Transfer Phase for Patterns A, B, C, and D Separately

Source	df	Pattern A			Pattern B			Pattern C			Pattern D		
		SS	MS	F	SS	MS	F	SS	MS	F	SS	MS	F
Experimental-Control (A)	1	136.69	136.69	33.60**	133.34	133.34	25.16**	16.52	16.52	4.63*	35.02	35.02	10.74**
Similar-Dissimilar (B)	1	13.02	13.02	3.21	75.00	75.00	14.15**	30.69	30.69	8.60**	9.19	9.19	2.82
AB	1	.02	.02		12.00	12.00	2.26	4.52	4.52	1.27	13.02	13.02	3.99
error	44	178.58	4.06		233.33	5.30		157.08	3.57		143.25	3.26	
Total	47	328.31			453.67			208.81			200.48		

* Significant at the .05 level
** Significant at the .01 level

interaction of these two variables. For Pattern A, the mean of 12.92 correct common terminating responses for similar stimuli under the experimental condition was greater (t = 4.17; p < .01) than the mean of 9.50 for similar stimuli under the control condition. The means for dissimilar stimuli under experimental and control conditions were 11.83 and 8.50 (t = 4.06; p < .01), respectively. While significantly more (t = 4.12; p < .01) correct responses were made under the experimental condition (M = 12.38) than under the control condition (M = 9.00), the mean of correct responses to similar stimuli (M = 11.21) was not significantly greater (t = 1.28; $p \doteq .10$) than that for correct responses to dissimilar stimuli (M = 10.16). The interaction of these two variables was also not significant.

For Pattern B, significantly more correct discriminative terminating responses occurred under the experimental condition (M = 11.08) than under the control condition (M = 7.75). An F of 14.15 (p < .01) indicated that significantly more correct responses occurred with dissimilar stimuli (M = 10.67) than with similar stimuli (M = 8.17). The means for similar and dissimilar stimuli under the experimental condition were 10.33 and 11.83 (t = 1.68; $p \doteq .10$), respectively, while the corresponding means under the control condition were 6.00 and 9.50 (t = 3.93; p < .01). Although the difference of 4.33 between means for similar stimuli under experimental and control conditions was greater

(t = 4.86; $p < .01$) than the corresponding difference of 2.33 for dissimilar stimuli (t = 2.62; $p \doteq .02$), the interaction was not significant.

For Pattern C, significantly more correct discriminative terminating responses were made under the control condition (M = 8.04) than under the experimental condition (M = 6.88). Also, significantly more correct responses occurred with dissimilar stimuli (M = 8.25) than with similar stimuli (M = 6.62). The means for similar and dissimilar stimuli under the experimental condition were 5.75 and 7.92 (t = 2.78; $p < .01$), respectively, while the corresponding means under the control condition were 7.50 and 8.58 (t = 1.38; $p \doteq .20$). However, the difference between these differences was not sufficient to produce a significant interaction.

The mean of 8.00 correct common terminating responses for similar stimuli under the experimental condition of Pattern D was less than the mean of 8.67 for the similar stimuli under the control condition (t = 0.90; $p \doteq .40$). With dissimilar stimuli, the means were 6.08 under the experimental condition and 8.83 under the control condition (t = 3.72; $p < .01$). Though the difference between these two differences was large, the F for the interaction fell just short of the .05 level. Disregarding similarity of stimuli, the mean of 8.75 for the control condition was significantly greater than the mean of 7.04 for the experimental condition. While more correct responses occurred with similar stimuli

(M = 8.34) than with dissimilar stimuli (M = 7.46), the difference was not significant; nor was the interaction significant.

Pattern A and Pattern D.--In the analysis of variance for Pattern A and Pattern D, for both of which there was a common terminating response, the Fs for experimental or control conditions, for similar or dissimilar stimuli, and for assignment to Pattern A or Pattern D were significant at or beyond the .05 level (Table 6). The F for experimental or control conditions was due to a difference of 3.38 in favor of the experimental condition for Pattern A which was greater than the difference of 1.54 in favor of the control condition for Pattern D. Thus the mean of 9.71 under the experimental condition exceeded that of 8.88 under the control condition. The other Fs were due to occurrence of more correct responses with similar (M = 9.78) than with dissimilar stimuli (M = 8.81), and of more correct responses with Pattern A (M = 10.69) than with Pattern D (M = 7.90). The main source of the interaction of Pattern A with Pattern D under experimental or control conditions was the greater number of correct responses under the experimental condition (M = 12.38) than under the control condition (M = 9.00) for Pattern A and the smaller number of correct responses under the experimental condition (M = 7.04) than under the control condition (M = 8.75) for Pattern D.

Pattern B and Pattern C.--Patterns B and C both involved

Table 6

Analyses of Variance of Correct Responses during the Transfer Phase for Patterns A and D and for Patterns B and C

Source	df	Patterns A and D			Patterns B and C		
		SS	MS	F	SS	MS	F
Experimental Control (A)	1	16.66	16.66	4.55*	27.09	27.09	6.10*
Similar-Dissimilar (B)	1	22.04	22.04	6.02*	102.09	102.09	22.99**
Patterns A and D (C) or Patterns B and C (C')	1	187.04	187.04	51.10**	94.01	94.01	21.17**
AB	1	7.05	7.05	1.93	1.27	1.27	.29
AC or AC'	1	155.05	155.05	42.36**	123.77	123.77	27.88**
BC or BC'	1	.17	.17	.05	4.60	4.60	1.04
ABC or ABC'	1	5.99	5.99	1.64	14.24	14.24	3.21
error	88	321.83	3.66		390.41	4.44	
Total	95	715.83			757.49		

* Significant at the .05 level
** Significant at the .01 level

discriminative terminating responses (Table 6). The Fs of the analysis of variance indicated that significantly more correct responses had occurred for Pattern B (M = 9.42) than for Pattern C (M = 7.46). Also, disregarding other factors, there were more correct responses under the experimental condition (M = 8.98) than under the control condition (M = 7.92) and with dissimilar stimuli (M = 9.46) than with similar stimuli (M = 7.40). Finally, the interaction of Pattern B or Pattern C under experimental or control conditions was significant. Since the means under the control condition were nearly equal, this interaction was due to more correct responses under the experimental condition (M = 11.08) than under the control condition (M = 7.75) for Pattern B and fewer correct responses under the experimental condition (M = 6.88) than under the control condition (M = 8.08) for Pattern C.

Discussion

Statistical analysis of the training data indicated that, regardless of other conditions, the common mediating response was acquired more rapidly than discriminative mediating responses. This was consistent with Lacey's (1956) finding of slower learning as the number of responses increased.

While two interactions were significant, the relationships among the means reflected in those interactions were not of a form which might have accounted for differences among conditions and combinations of conditions obtained during the transfer phase. On the whole, therefore, differences among the groups with respect to training were nonsignificant or unimportant. Of greater importance was the finding that the sets of similar faces and of similar houses did not differ in difficulty; this was also the case for the sets of dissimilar faces and of dissimilar houses.

The over-all analysis of variance of numbers of correct responses during the transfer phase was of a form which could be treated more conveniently and more meaningfully by beginning with findings for all four patterns combined and proceeding to those for each pattern separately. The sets of predictions, however, were developed in the opposite direction, and it is this direction which will be followed in comparisons of predicted with observed relationships.

Considered first are comparisons of predicted with observed relationships for similar and dissimilar initiating stimuli under experimental or control conditions for Patterns A, B, C, and D separately. Then discussed are hypotheses and results involving Patterns A and B and those involving Patterns C and D. After predictions and results involving Patterns A and B and involving Patterns C and D are considered, findings with respect to all 16 combinations are treated.

Patterns A, B, C, and D separately.--For Pattern A, in which acquisition of a common mediating response was followed by acquisition of a common terminating response, more correct terminating responses were expected under experimental than under control conditions and with similar than with dissimilar stimuli. Both of these expected differences occurred, but only the former was statistically significant.

The interaction of these two variables was not significant. There was no evidence, therefore, for the suggestion that the effects of a common mediating stimulus on acquisition of a common terminating response might be different for dissimilar than for similar initiating stimuli. However, as noted, neither the rationale nor the empirical grounds for this suggestion was compelling. Further, other factors may have precluded a significant interaction. For example, the mediating stimuli may have constituted such a large part of the compounds of initiating and mediating stimuli that even relatively large differences in the similarity of

initiating stimuli could produce only relatively small, difficult-to-detect differences in similarity of the compounds. Or, the differences in similarity of the similar with respect to the dissimilar initiating stimuli may not have been sufficient to produce a significant interaction. Either of these factors might have also precluded a significant interaction of experimental or control conditions with similar or dissimilar stimuli for Patterns B, C, and D.

Under the experimental condition with Pattern B, discriminative mediating responses were acquired to either similar or dissimilar initiating stimuli; subsequently discriminative terminating responses were acquired. The prediction that the presence of discriminative mediating responses and stimuli would lead to more correct discriminative terminating responses under the experimental condition was confirmed. Also confirmed was the prediction that discriminative terminating responses to dissimilar stimuli would be learned faster than such responses to similar stimuli. However, the relatively greater facilitation under the experimental condition than under the control condition with similar than with dissimilar initiating stimuli which had been anticipated was not obtained. Two possible reasons for this nonsignificant interaction were noted in connection with the nonsignificant interaction for Pattern A.

With Pattern C, a common mediating response was learned to initiating stimuli and then discriminative terminating

responses were associated with those same stimuli. Slower acquisition rates of the terminating response were predicted under the experimental than under the control condition. This prediction and the expectation of slower learning with similar than with dissimilar initiating stimuli were both confirmed. Not confirmed, however, was the prediction of greater retardation under the experimental condition with dissimilar stimuli than with similar initiating stimuli. Again, the reasons may be those mentioned for Pattern A.

The acquisition of different mediating responses with Pattern D was followed by acquisition of a common terminating response. The predicted slower learning under the experimental than under the control condition or negative transfer, as anticipated, was obtained and the difference was statistically significant. Fewer correct responses occurred with dissimilar than with similar initiating stimuli, but the difference was not significant. The prediction that acquisition rates with similar and dissimilar initiating stimuli would not differ less under the experimental than under the control condition was not confirmed. In fact, the obtained relationship among the four means was opposite that predicted.

Pattern A with Pattern B and Pattern C with Pattern D.--In addition to predictions of positive transfer for both Pattern A and Pattern B already noted, it was expected that the common terminating response of Pattern A would be

mastered more rapidly than the discriminative terminating responses of Pattern B. Predicted, also, was an interaction in the form of more correct responses with similar than with dissimilar initiating stimuli for Pattern A and the converse for Pattern B. All three hypotheses were confirmed.

The predicted negative transfer was obtained with both Pattern C and Pattern D, while the common terminating response of Pattern D was correct more often than the discriminative terminating responses of Pattern C, as anticipated, but the difference was not significant. With Pattern C, correct responses occurred more frequently with dissimilar than with similar stimuli, and with Pattern D more correct terminating responses occurred with similar than with dissimilar initiating stimuli. This was the predicted interaction.

Pattern A with Pattern D and Pattern B with Pattern C.--While Pattern A and Pattern D both had a common terminating response, Pattern A involved a common mediating response and Pattern D involved discriminative mediating responses. Because mediating stimuli presumably increased similarity of initiating stimuli in the former pattern and decreased such similarity in the latter pattern, positive transfer was predicted for Pattern A and negative transfer for Pattern D. The obtained significant interactions confirmed this prediction. Further, the positive transfer for Pattern A outweighed the negative transfer for Pattern D. While

similarity of initiating stimuli did not have significant effects for Pattern A or Pattern D separately, for the two patterns combined, significantly more correct responses occurred with similar than with dissimilar initiating stimuli.

Pattern B involved discriminative mediating responses and Pattern C involved a common mediating response; both had discriminative terminating responses. The predictions were of better performance for Pattern B than for Pattern C with dissimilar stimuli than with similar initiating stimuli. Also expected was a significant interaction based on positive transfer for Pattern B and negative transfer for Pattern C. These predictions were confirmed. Also, the facilitation for Pattern B exceeded the retardation for Pattern C.

All 16 combinations.--The largest number of correct terminating responses, as predicted, was obtained for Pattern A with similar initiating stimuli under the experimental condition. Also, as predicted, the smallest number of correct terminating responses occurred for Pattern C with similar initiating stimuli under the experimental condition. The remaining 14 combinations of conditions were at intermediate levels of achievement.

Against controls which provided for effects of warm up and receptor-orienting responses, Pattern A and Pattern B led to positive transfer and Pattern C and Pattern D led to negative transfer. The nature of the mediating responses, therefore, as predicted, apparently determine whether

acquisition of common or discriminative terminating responses is facilitated or retarded.

Degree of similarity of the initiating stimuli produced differences in the predicted direction with all four patterns. Specifically, more correct common terminating responses occurred with similar stimuli than with dissimilar stimuli for Patterns A and D and with dissimilar than with similar stimuli for Patterns B and C. Only with Patterns B and C, however, were the differences between similar and dissimilar initiating stimuli significant. Since both of these patterns involved discriminative terminating responses, similarity of initiating stimuli may have relatively greater effects on transfer tasks involving discrimination than on those involving generalization.

In general, the findings support the notion that verbal mediating responses and stimuli play an important role in conceptual naming. Further, these results for conceptual naming both support and extend previous findings of the importance of mediating verbal responses and stimuli in conceptual sorting.

SUMMARY

The significance of verbal mediating responses and stimuli in conceptual naming was investigated by means of a design in which four patterns of possible relationships among initiating stimuli, mediating stimuli and responses, and terminating responses were combined with sets of similar or dissimilar initiating stimuli. The patterns involved initiating stimuli to which Ss learned (a) a common mediating response and then a common terminating response (Pattern A), (b) discriminative mediating responses and then discriminative terminating responses (Pattern B), (c) a common mediating response and then discriminative terminating responses (Pattern C), and (d) discriminative mediating responses and then a common terminating response (Pattern D). The sets of similar initiating stimuli consisted of stylized line-drawings of faces or of houses which differed along but one dimension. The sets of dissimilar faces or houses differed along three dimensions.

Ninety-six children of ages eight to 11, in grades two through six were assigned to eight groups of 12 Ss each, equated as nearly as possible for age, sex, and I.Q. Both mediating and terminating responses were three-letter nonsense syllables which were conditioned to the initiating stimuli by the paired-associates technique. Acquisition of mediating responses was to adjusted learning criteria; 32

trials were allowed for acquisition of terminating responses. Under the experimental condition the face or house stimuli for both training and transfer phases were the same. For the transfer phase under the control condition the faces or houses were replaced by houses and faces, respectively.

Comparisons of experimental and control conditions indicated that the predicted positive transfer had occurred with both Pattern A and Pattern B. Faster learning was obtained with similar stimuli for Pattern A and with dissimilar stimuli for Pattern B. Also confirmed were predictions of negative transfer under the experimental condition with Pattern C and Pattern D and of faster learning with similar stimuli for Pattern D and with dissimilar stimuli for Pattern C. The common terminating response of Patterns A and D were acquired faster than the discriminative terminating responses of Patterns B and C, respectively. On the whole, the experimental findings were interpreted as consistent with the general notion of the importance of verbal mediating responses in concept formation as well as with predictions based on the four different patterns of relationships among initiating stimuli, mediating responses and stimuli, and terminating responses each in combination with similar and dissimilar initiating stimuli.

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APPENDIX

Instructions

Familiarization with Mediating Responses

I want to see how well you can learn three names. They are not real names or names that you have heard before; but you should say them just like other names you know. Each time I say one of these three names I want you to say it just the way I do.

At the same time try to learn each name because after a while I'm going to ask you to tell me the three names and when I do you should be able to do so. Any questions?

Now, tell me the three names.

You forgot to tell me _____. Let me say the names some more. Remember, say them just like I do and try to learn all of them because I'm going to ask you to tell me the three names again and when I do you should be able to do so.

Now, tell me the three names.

Training Phase

Now this is a game in which you have to learn the names of different pictures.

When the game begins I will drop a card in this opening and you will see a colored picture. The picture that you will see has a name. You are to try to find out its name. The name will be one of the three names that you have just learned, that is, DIT, NAZ, or HUV. As soon as you think you know which of these names is the right one for the picture, tell me that name. If the name you say is the right name for the picture, I'll say, "Yes, that's right." If the name you say isn't the right name for the picture I'll say, "No" and tell you the right name for the picture. After I tell you the right name, you should repeat that name. After you've seen the first picture and tried to learn its name, I'll drop another card in the opening and you'll see another picture. The name of this picture will also be DIT, NAZ, or HUV. And you should tell me which one you think it is. If you guess the right name, I'll tell you that you are right, and if you guess the wrong name, I'll say, "No, that's wrong" and tell you the right name. And then you should repeat that name.

In all you are going to see a number of different pictures in the opening and your job will be to guess the right name for each picture. Some will be named DIT, some will be named NAZ, and some will be named HUV. You are to learn which name goes with which picture. To do this, as soon as I put a card in the opening you should say what you think the name of the picture is. I'll always tell you whether you guessed the right name or the wrong name. If you say the wrong name you should repeat the right name after I tell it to you. As soon as you have any idea about the name for each picture, say it, because if it's wrong I won't count it against you, and you might guess the right name. Don't feel badly if you don't guess the names right away. It always takes people some time. However, you can learn the names of all the pictures if you try hard.

The only way you can learn each picture's name is first to pay attention to it when it appears in the opening and then try to guess the name of the picture.

Remember, you are to try to tell me the right name for each picture.

(If Ss seem puzzled after 3 or 4 trials stop and ask if they have any questions.)

Familiarization with Terminating Responses

Now I want to see how well you can learn three new names. Except that these are new names you should do like you did before: after I say each name you should say it exactly like I do. And try to learn these new names because after a while I'm going to ask you to tell me what they are.

Remember, say the name exactly as I do. Also try to memorize the names so that, when I ask you to tell me what they are, you can do so.

Now, tell me the three names.

You forgot to tell me _____. Let me say the names some more. Remember, say them just like I do and try to learn all of them because I'm going to ask you to tell me the three names again and when I do you should be able to do so.

Now, tell me the three names.

Transfer Phase

Now we're going to play the same game that we played before.

When the game begins I will drop a card in this opening and you will see a colored picture. The picture that you will see has a name. You are to try to find out its name. The name will be one of the three names that you have just learned, that is, it will be GOS, CEY, or BAW. As soon as you think you know which of these names is the right one for the picture, tell me that name. If the name you say is the right name for the picture, I'll say, "Yes, that's right." If the name you say isn't the right name for the picture, I'll say, "No" and tell you the right name for the picture. After I tell you the right name you should repeat that name as soon as I tell it to you. After you've seen the first picture and tried to learn it's name, I'll drop another card in the opening and you'll see another picture. The name of this picture will also be GOS, CEY, or BAW. And you should tell me which one you think it is. If you give the right name I'll tell you that you are right, and if you guess the wrong name, I'll say "No, that's wrong" and tell you the right name. And you should repeat this name.

In all you are going to see a number of different pictures in the opening and your job will be to guess the right name for each picture. Some will be named GOS, some will be named CEY, and some will be named BAW. You are to learn which name goes with each picture. To do this, as soon as the door opens you should say what you think the name of the picture is. I'll always tell you whether you guess the right name or the wrong name. If you say the wrong name you should repeat the right name that I tell you. As soon as you have any idea always try to guess the name for each picture you see. Say that name, because if it's wrong I won't count it against you, and you might guess the right name. Don't feel badly if you don't guess the names right away. It always takes people some time. However, you can learn the names of all the pictures if you try hard.

The only way you can learn each picture's name is first to pay attention to it when it appears in the opening and then to try to guess the name of the picture.

Remember, you are to try to tell me the right name for each picture.

Individual Data for Training and Transfer Phases

Groups*	Subjects' Initials	Age	Sex	I.Q.	Number of Trials to First Training Criterion		Number Correct during Transfer Phase	
					Common	Discriminative	Common	Discriminative
Patterns A and B, Similar stimuli, Experimental, Faces	S.S.	11	F	95	28	30	15	12
	G.W.	9	M	117	5	14	13	11
	K.T.	10	M	96	20	33	13	10
	R.M.	10	M	107	9	18	14	12
	J.G.	10	F	109	8	20	13	10
	S.G.	9	F	99	25	30	13	7
Patterns A and B, Similar stimuli, Experimental, Houses	H.G.	10	M	103	16	32	11	11
	M.K.	11	F	96	26	30	11	13
	W.G.	8	F	107	28	42	12	7
	L.L.	9	F	106	27	38	13	11
	L.R.	10	M	95	23	10	13	8
	K.D.	10	M	122	11	12	14	8
Patterns A and B, Dissimilar stimuli, Experimental, Faces	V.F.	10	F	99	45	53	9	11
	S.D.	10	M	93	13	15	12	14
	R.K.	9	M	124	5	26	15	12
	G.W.	11	M	97	25	34	12	10
	R.G.	11	F	104	23	36	13	14
	R.S.	10	F	100	26	30	13	14
Patterns A and B, Dissimilar stimuli, Experimental, Houses	H.L.	10	F	111	27	40	13	9
	B.G.	11	M	108	22	26	13	12
	M.G.	9	M	105	13	29	11	13
	L.S.	11	F	96	10	22	8	11
	B.L.	11	F	103	20	30	13	11
	B.H.	10	M	91	20	24	7	9

* Each group is described in terms of combinations of conditions. Given first are assignment to Patterns A and B or C and D, and then whether the stimuli were similar or dissimilar. Given third is whether under the experimental or control conditions and, given finally, whether faces or houses.

Individual Data for Training and Transfer Phases (continued)

Groups*	Subjects' Initials	Age	Sex	I.Q.	Number of Trials to First Training Criterion		Number Correct during Transfer Phase	
					Common	Discriminative	Common	Discriminative
Patterns A and B, Similar stimuli, Control, Faces	J.C.	10	F	94	16	19	7	6
	D.K.	11	F	98	15	24	11	5
	G.N.	11	M	99	10	18	6	4
	L.S.	9	M	101	21	35	7	7
	M.G.	9	M	119	23	40	9	6
	G.M.	10	F	105	28	30	11	6
Patterns A and B, Similar stimuli, Control, Houses	S.L.	9	M	115	21	29	12	8
	A.J.	10	F	123	8	25	11	7
	J.F.	11	M	104	20	29	9	6
	S.K.	10	F	94	22	32	9	6
	H.L.	9	F	101	21	41	10	7
	T.G.	11	M	95	22	38	12	6
Patterns A and B, Dissimilar stimuli, Control, Faces	J.K.	10	F	103	6	11	9	10
	A.W.	11	M	94	14	15	13	8
	R.J.	9	M	106	20	23	8	9
	H.C.	10	F	113	24	27	6	11
	K.T.	11	F	98	27	30	7	11
	N.G.	8	M	103	29	13	10	11
Patterns A and B, Dissimilar stimuli, Control, Houses	D.W.	10	M	105	39	39	8	7
	C.R.	10	F	112	12	22	7	9
	L.W.	11	M	123	19	18	9	12
	R.K.	11	M	93	31	43	8	10
	B.J.	8	F	94	20	36	6	9
	P.S.	9	F	99	15	14	11	6

Individual Data for Training and Transfer Phases (continued)

Groups*	Subjects' Initials	Age	Sex	I.Q.	Number of Trials to First Training Criterion		Number Correct during Transfer Phase	
					Common	Discriminative	Common	Discriminative
Patterns C and D,	N.K.	11	M	100	9	25	8	5
Similar stimuli,	R.Z.	9	M	124	17	27	7	8
Experimental,	B.M.	10	F	96	23	25	7	5
Faces	S.G.	8	F	102	18	31	9	4
	S.H.	11	F	98	25	12	7	7
	B.L.	11	M	98	22	35	7	6
Patterns C and D,	V.D.	10	F	99	21	35	9	4
Similar stimuli,	T.S.	10	M	110	15	27	8	4
Experimental,	C.K.	11	M	113	33	28	9	6
Houses	J.B.	9	F	100	31	40	9	5
	B.D.	8	F	104	13	25	8	6
	J.M.	11	M	91	15	31	7	10
Patterns C and D,	D.D.	10	F	107	11	26	5	7
Dissimilar stimuli,	G.V.	11	M	122	18	21	5	9
Experimental,	W.K.	8	M	107	22	33	8	9
Faces	P.J.	11	M	97	17	19	9	10
	A.T.	10	F	95	14	27	4	7
	B.R.	9	F	102	19	25	6	7
Patterns C and D,	B.B.	11	F	97	22	35	8	5
Dissimilar stimuli,	M.F.	11	M	106	16	31	4	9
Experimental,	W.G.	10	F	92	29	48	6	6
Houses	D.R.	9	M	103	19	26	4	7
	M.N.	10	F	104	6	12	6	12
	L.K.	8	M	117	18	20	8	9

Individual Data for Training and Transfer Phases (continued)

Groups*	Subjects' Initials	Age	Sex	I.Q.	Number of Trials to First Training Criterion		Number Correct during Transfer Phase	
					Common	Discriminative	Common	Discriminative
Patterns C and D, Similar stimuli, Control, Houses	A.V.	10	M	106	8	22	9	9
	B.A.	9	F	100	35	40	11	6
	C.G.	11	M	113	23	40	8	8
	Y.G.	11	F	94	16	25	7	6
	J.W.	8	M	103	25	29	11	6
	B.Z.	10	F	96	12	23	9	7
Patterns C and D, Similar stimuli, Control, Faces	J.H.	10	F	123	4	15	8	5
	S.G.	11	M	95	22	31	7	10
	B.C.	8	M	100	24	25	8	7
	P.J.	10	F	107	26	22	5	7
	S.R.	9	F	98	17	10	13	12
	B.W.	11	M	96	28	41	8	7
Patterns C and D, Dissimilar stimuli, Control, Faces	I.G.	11	M	96	8	20	12	10
	K.N.	11	F	98	16	29	11	12
	M.S.	10	M	102	34	23	9	10
	C.T.	9	F	94	17	26	7	9
	R.D.	8	F	111	6	38	9	7
	J.F.	10	M	102	20	27	7	6
Patterns C and D, Dissimilar stimuli, Control, Houses	P.P.	10	F	103	5	20	10	9
	B.A.	10	M	103	18	30	10	6
	D.L.	11	M	116	10	22	8	5
	P.K.	9	F	94	8	34	8	10
	L.L.	8	M	110	19	16	10	9
	N.R.	11	F	92	20	30	6	9

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